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THE ARTHROCERAS OF THE WORLD
(Diptera: Rhagionidae)[1]

By Akira Nagatomi[2]

Abstract: The genus *Arthroceras* is revised. It contains 7 species and 2 subspecies, and is distributed in North America, Siberia, East China, and Japan. Three species and 2 subspecies are described as new.

The genus *Arthroceras* Williston, 1886 has been placed at various times in the Rhagionidae, Coenomyiidae, and Xylophagidae. It seems to me that this genus is more closely related to *Rhagio* Fabricius, 1775 and its allies than to *Coenomyia* Latreille, 1796 or *Xylophagus* Meigen, 1803 (=*Erinna* Meigen, 1800).

Leonard revised this genus in 1930 when 2 North American species were known. Nagatomi added a new species from Japan in 1954 and synonymized *Pseudocoenomyia* Ouchi, 1943, which included 1 new species from East China, with *Arthroceras* in 1955.

This paper describes 2 new species and 2 new subspecies from North America and 1 new species from Japan, gives a translation of the original description of *A. sinense* (Ouchi 1943), and appends some notes to the works of Leonard (1930) and Nagatomi (1954). I have no knowledge of the biologies and immature stages of this genus.

The following symbols indicate the institutions where the specimens are deposited:

CNC—Canada Department of Agriculture, Ottawa
USNM—U. S. National Museum, Washington, D. C.
COR. U—Cornell University, Ithaca, New York
U. CAL—University of California, Berkeley
NIAS—National Institute of Agricultural Sciences, Tokyo
KA. U—Kagoshima University, Kagoshima

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2. Bishop Museum, Honolulu, Hawaii (Permanent address: Faculty of Agriculture, Kagoshima University, Kagoshima, Japan).

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Genus **Arthroceras** Williston

Arthroceras Will., 1886, Ent. Amer. **2**: 107.

Pseudocoenomyia Ouchi, 1943, Shanghai Sizenkagaku Kenkyusyo Iho **13**(6): 493. (See footnote 2 of "Mushi **29**(9): 57, 1955").

Eyes contiguous in ♂ but widely separated in ♀; front of ♀ becomes considerably wider on vertex, and its narrowest point, which is situated near antenna, is equal to or nearly as wide as one eye; distance from proboscis to antenna equal to or roughly so that from antenna to median ocellus; central part of face swollen but its ridge at about same level as side of face; face is fine pilose or may be practically bare especially in ♀; in antenna, 1st 2 segments subglobose in form and subequal in length, and 3rd composed of 7-8 (in *fulvicorne subsolanum* n. subsp., 5-6) divisions of which last is elongate and acute at tip; palpus consists of 2 segments of which 1st is nearly as long as or shorter than 2nd. Scutellum 1/2 or more times as long as its basal width. Wing with 5 posterior cells and both 4th posterior cell and anal cell open. Tibial spurs are 0 : 2 : 1; hind coxa has a mid-ventral, knob-like process. The integument of abdomen appears to be not as strong as in *Coenomyia*, *Stratiomys* Geoffroy, 1762, etc., but weak as in *Rhagio*, *Chrysopilus* Macquart, 1826, etc.; in ♂ genitalia, basistyli gradually tapering toward apices.

Type-species: *Arthroceras pollinosum* Williston.

This genus is similar to *Chrysopilus* in general appearance, shape of face and ♂ genitalia, and number of tibial spurs, but is at once distinguishable from the latter by the shape of antenna and venation of wing. In *Chrysopilus* the 3rd antennal segment is simple and has a terminal arista, and the anal cell is closed.

The genus is also similar to *Glutops* Burgess, 1878 and *Tamayura* Nagatomi, 1955, both of Coenomyiidae, in the shape of antenna, venation of wing, and number of tibial spurs but is easily separated from both by the general appearance, and the shape of face and ♂ genitalia. In *Glutops* and *Tamayura* the body is more robust and the integument of abdomen appears to be strong, scutellum is short (less than 1/2 as long as its basal width), either facial swelling or sides of face are conspicuously produced forward, and the hairs on face are long and strong, and the basistyli of ♂ genitalia are not tapering toward apices.

Arthroceras is not related to *Xylophagus* in any respect. In *Xylophagus* the last flagellar segment of antenna is short and broad and obtuse at the tip; in the ♀ the lower portion of front and upper portion of face are conspicuously produced forward and in both sexes the eyes are widely separated and the central part of face is not swollen but flat, the postscutellum is greatly developed, the tibial spurs are 1 : 2 : 2, the anal cell is closed, and the shape of ♂ genitalia is also very different from either that of *Arthroceras* and *Chrysopilus* or that of *Glutops* and *Tamayura*.

Williston (1886) expressed his opinion as follows: "No one who will compare the present [*Arthroceras*] with other species of Leptidae [*Rhagionidae*] will for a moment doubt the family relationship. It must unquestionably be placed under the Leptidae, and not with

the Coenomyidae or Xylophagidae."

Malloch (1932) wrote as follows: "I am rather inclined to accept characters of the thoracic structure as more reliable indices to the relationships of groups than the structure of the antennae, or even the venation of the wings, there being rather too many parallelisms in the two last features to justify much faith being placed in them. I therefore place the present genus [*Arthroceras*].....in Rhagionidae, though I am disinclined to deal with the matter of their subfamily status at this time."

Key to species of Arthroceras of the world

1. Apex of wing darkened (fig 19); abdomen shining and at least on terga 2-5 without pollen; abdomen of ♂ yellowish brown at least on segments 2 and 3 each of which has a dorsal, median blackish spot; body larger, 7.5-11 mm in ♂ and 9.5-15 mm in ♀ 2

   Wing not as above; abdomen dull and distinctly pollinose (in ♀ of *fulvicorne* and *subaquilum* pollen on abdomen may not be as conspicuous); abdomen of ♂ not spotted (as well as in ♀) and dark brownish to blackish in ground color; body smaller, 4.5-8 mm in ♂ and 5.5-12 mm in ♀ 4

2 (1). Thorax wholly and legs at least partially blackish; abdomen of ♀ wholly blackish, although some basal terga (at sides) and sterna often yellowish brown.....3

   Thorax and legs yellowish brown; abdomen of ♀ wholly yellowish brown (E. China)..... **sinense**

3 (2). Stigma of wing yellowish brown and not distinctly marked; in ♀, front reddish brown (Japan)..... **rubrifrons** n. sp.

   Stigma of wing nearly blackish; in ♀, front velvety black (Japan)..... **japonicum**

4 (1). Length of last antennal segment less than 1.5× width of 3rd segment (figs 4-6); hais on hind femur shorter (fig 2) 5

   Length of last antennal segment more than 1.5× width of 3rd segment (fig 3); hairs on hind femur longer (fig 1); antenna and abdomen dark brownish to blackish in ground color; pollen on body, especially mesonotum yellowish gray; wing tinged with yellowish; at least in ♀ haltere and femur wholly yellowish brown; body 4.5-6 mm in ♂ and 5.5-8 mm in ♀ (N. America) ... . **pollinosum**

5 (4). In both sexes palpus and femur and in ♀ haltere yellowish brown to brownish...6

   Antenna, palpus, femur, knob of haltere and abdomen dark brown to blackish in ground color; pollen on body light gray and wing somewhat tinged with brown to dark brown; body 6-7 mm in ♂ and 7-10 mm in ♀ (N. America, Siberia, Japan) (the ♂ of *subaquilum* may fall under this heading; see page 59, last paragraph) ..... **leptis**

6 (5). In ♀, flagellum of antenna largely darkened and abdominal terga 1-4, except posterior borders, dark brownish to blackish; in ♂, palpus may be dark brown and antenna except for basal portion of 1st flagellar segment may be blackish, in ♀ pollen on body (appears to be) yellowish gray and wing tinged with dark brown but veins bordered with yellowish brown, and body 8-9 mm (N. America)..... **subaquilum** n. sp.

   In ♀, antenna and abdomen wholly yellowish brown to brownish; in ♂, palpus

at least 2nd segment and antenna at least basal segment of flagellum yellowish brown to brown; in ♂ pollen on body is light gray and wing is brown fumose but in ♀ former appears to be yellowish gray and latter tinged with yellowish brown to brownish; body 6.5-8 mm in ♂ and 8.5-12 mm in ♀ (N. America)..... **fulvicorne** n. sp....7

7 (6). In ♀, flagellum of antenna 7 or 8 segmented (fig 5) 8
In ♀, flagellum of antenna 5 or 6 segmented (fig 6) (New Hampshire, Michigan) ..... **fulvicorne subsolanum** n. subsp.

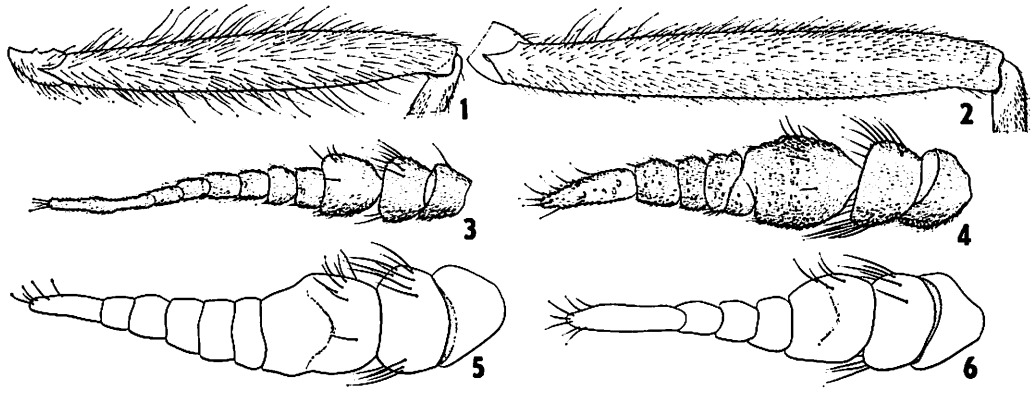
8 (7). In ♀, head yellowish brown to brownish (British Columbia, Washington, Idaho, Oregon, Utah, Colorado) ..... typical **fulvicorne**
In ♀, head (except antenna, palpus, and proboscis) almost blackish in ground color (California)..... **fulvicorne nigricapite** n. subsp.

Arthroceras fulvicorne Nagatomi, n. sp. Figs. 2, 4-5, 7-10.

In addition to characters given in the key, this species may be differentiated from *leptis* by the palpi in which segment 2 is 1.5-1.7× in ♂ and 2-3× in ♀ as long as segment 1, rather than 0.9-1.4× in ♂ and 1.1-1.9× in ♀.

The ♀ is similar to that of *pollinosum*, but may be easily separated by shorter antenna (1.2-1.5× distance from antenna to median ocellus), shorter pile on hind femur, wholly yellowish brown to brownish abdomen, and larger body (8.5-12 mm). The ♀ is also most closely related to that of *subaquilum*, but may be distinguished from latter by its antenna and abdomen wholly yellowish brown to brownish and stigma of wing yellowish brown to brownish.

♂. *Head*: Dark brownish to blackish, pale gray pollinose; antenna (especially basal segment of flagellum) and palpi (at least segment 2) yellowish brown to brown; (1) vertex, (2) ocellar triangle, (3) facial swelling, (4) palpi, (5) proboscis, (6) cheeks, and (7) occiput with pale pile which is long on (4) and (6) and sometimes changes into partial-



Figs. 1-6. 1, hind femur (anterior view) of *Arthroceras pollinosum*, ♂; 2, same, *A. f. fulvicorne*, ♂; 3, antenna (inner view; macerated in KOH solution) of *A. pollinosum*, ♂; 4, same, *A. f. fulvicorne*, ♂; 5, same (in dried condition; microscopic pile is omitted), *A. f. fulvicorne*, ♀ (from British Columbia); 6, same, *A. fulvicorne subsolanum*, ♀ (from New Hampshire).

ly or wholly black on (4) and (5); structural characters as in description of *japonicum*, but in specimens at hand width of one eye on a mid line from a direct frontal view 0.9-1.0× width of face at lowest part from a direct frontal view, segment 2 of palpus 1.5-1.7× as long as segment 1 of palpus and 0.7-0.8× as broad as segment 3 of antenna, distance from antenna to median ocellus 1.0-1.2× that from proboscis to antenna, 1st 3 antennal segments 0.8-0.9× as long as remainder and last segment 0.7-0.9× as long as segments 1+2 and 0.9-1.1× as long as width of segment 3.

Thorax: Dark brownish to blackish, pale gray pollinose; mesonotum with 3 obscure dark broad stripes of which the median one is divided by a thin line; mesonotum and scutellum with pale erect pile which is longer on latter; pro-, sterno-, meta-, upper and posterior portion of meso-, and pteropleura below posterior spiracle pale pilose; haltere yellowish brown to brownish, but knob somewhat darkened.

Legs: Coxa same as pleura, but apical portion, as well as femur and tibia, yellowish brown to brownish; tarsus with at least apex darkened; hairs on coxa pale; fore and mid femur with ventral and posterior surface pale pilose and dorsal and aterior surface short black-haired; hind femur with short, partially or almost wholly black hairs which may become longer and pale on dorsoproximal portion (fig 2); relative length[3] of segments (excluding coxa and trochanter) of fore leg 164(156-172) : 200(196-203) : 100 : 37(35-38) : 33(32-33) : 24(23-25) : 33(30-35), of mid leg 173(166-180) : 213(208-217) : 90(89-90) : 37(35-38) : 31(30-32) : 23 (23) : 28(26-30), of hind leg 233(217-248) : 277(275-278) : 115(112-118) : 44(42-45) : 33(33) : 23(23) : 32(28-35), these were calculated on the basis of 2 specimens (from Washington and Colorado).

Wings: Membrane brown fumose, stigma and apical portion of subcostal cell somewhat darker; veins largely yellowish brown.

Abdomen: Dark brownish to blackish, pale gray pollinose; dorsum rather sparsely clothed with hairs which are longer and pale on sides and shorter and black in middle; venter short, wholly or chiefly pale pilose (sternum 1 bare).

Genitalia: As in figs 7-10; genitalia may not be so useful in separating species, although sterna 7 and 8 are different in shape between *fulvicorne* and *pollinosum* or *japonicum*.

Length: Body 6.5-8 mm; wings 6.0-7.5; fore basitarsi 0.8-1.15.

♀. Similar to ♂ except as follows: *Head*: Yellowish brown to brownish, with pale gray pollen which may be tinged with yellowish; proboscis brownish to dark brownish; palpi and antenna are yellowish brown to brownish, but apex of flagellum may be darkened; front and median occipital region pale pilose; pile on palpi pale in all specimens on hand and not so long as in ♂, and that on proboscis sometimes black; structural characters as in description of *japonicum*, but segment 2 of palpus 1.8-3.0× as long as 1, width of one eye at broadest point from a direct frontal view 1.0-1.3× distance from antenna to median ocellus, 1st 3 antennal segments 0.7-1.0× as long as remainder and length of last segment 0.7-1.2× combined length of segments 1+2.

Thorax: Yellowish brown to brownish, with pale gray pollen which may be tinged with yellowish; haltere wholly yellowish brown.

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3. The length of each segment of legs was measured along the dorsal surface and the average and the two extremes of the value were given. The front basitarsi were adopted as a unit for determining the proportions of parts.

Legs: Coxa wholly yellowish brown to brownish; hairs on femur often almost wholly pale; relative length of segments of fore leg 173(164-181) : 197(186-210) : 100 : 35(34-38) : 28(26-30) : 21(20-23) : 33(30-35), of mid leg 200(187-213) : 222(211-245) : 94(90-98) : 35(31-37) : 27(25-30) : 18(17-20) : 32(28-34), of hind leg 258 (244-274) : 298 (282-317) : 114(106-121) : 43(39-47) : 32(29-33) : 20(17-23) : 33(31-35), these were calculated on the basis of 10 specimens from British Columbia.

Wings: Membrane tinged with yellowish brown to brownish; stigma and apex of subcostal cell yellowish brown to brownish.

Abdomen: Yellowish brown, more or less pale gray pollinose; hairs on abdomen usually wholly pale.

Length: Body 8.5-12 mm; wings 7.5-10.5; fore basitarsi 1.0-1.5.

DISTRIBUTION: N. America (British Columbia, Washington, Idaho, Oregon, Utah, and Colorado).

Holotype: 1♀, Robson, British Columbia, 21.VI.1948, H. R. Foxlee (CNC, 9100).

Paratypes: British Columbia: 1♂, 19♀♀, Robson, 8.V-28. VII. 1940-1961, H. R. Foxlee (CNC); 2♀♀, Robson, 2-3.VI.1957, Foxlee (COR. U); 1♀, Chase, 20.VI.1926, W. B. Anderson (CNC); 1♀, Oliver, 24.VII.1953, J. E. H. Martin (CNC); 2♀♀, E. Grand Forks, 8.VI.1959, L. A. Kelton (CNC). Washington: 1♂, Mt Baker, 11.VIII.1925, A. L. Melander (USNM); 1♀, Mt Rainier, 24.VII.1924, Melander (USNM). Idaho: 1♀, Moscow Mt, 8. VII. 1911 (COR. U). Oregon: 1♀, Wallowa Lake, 17. VII. 1949, G. H. & J. L. Sperry (USNM); 1♀, Joseph, 14. VII. 1950, G. H. & J. L. Sperry (USNM). Utah: 1♀, Logan Canyon, 8.VII.1955, S. L. Wood (CNC). Colorado: 1♂, Loveland Pass, 28. VII. 1961, B. H. Poole (CNC).

A ♂ specimen from Idaho (Long Valley, Alpha, 20. V. 1934, C. H. Martin) appears to belong to this species. The structural and color characters (antenna, palpi, and femur yellowish brown to brownish and abdomen above and below with a concolorous tinge) agree but the hairs on femur and abdomen wholly pale.

Arthroceras fulvicorne nigricapite Nagatomi, n. subsp.

♀. There are 5 specimens from California which I have seen and which seem to be distinguished from the typical *fulvicorne* by the head being almost blackish in ground color (except for antenna, palpi, and proboscis).

In these 5 specimens, width of one eye at broadest point from a direct frontal view 1.3-1.4 × distance from antenna to median ocellus and 1.2-1.3× width of front at narrowest point just above antenna, and 1st 3 antennal segments 0.6-0.8× as long as rest (in typical *fulvicorne* they are 1.0-1.3×, 0.9-1.2×, and 0.7-1.0× respectively), thorax brownish to blackish in ground color (in typical *fulvicorne* thorax yellowish brown to brownish), and relative length of segments of fore leg 148(134-161) : 185(176-194) : 100 : 34(31-36) : 27 (26-28) : 19(18-20) : 26(25-27); of mid leg 172(164-186) : 200(195-209) : 93(92-95) : 34 (32-36) : 26(25-28) : 16(15-18) : 27(24-28); of hind leg 223(214-244) : 258(248-277) : 110 (97-118) : 41(39-44) : 28(26-30) : 19(17-20) : 27(25-30) (compare with those of tipical *fulvicorne*).

♂. No differences have been observed between typical *fulvicorne* and specimens from

California [1♂, Hope Valley, Alpine Co, 18. VII. 1948, L. W. Quate (U. CAL), and 1♂, Lassen Pk, Shasta Co, 18.VII.1949, E. L. Atkinson (U. CAL)]. (In 1 specimen from California relative length of segments of fore leg 166 : 198 : 100 : 38 : 29 : 24 : 31; of mid leg 176 : 207 : 95 : 36 : 29 : 21 : 29; of hind leg 215 : 257 : 107 : 41 : 31 : 21 : 31).

DISTRIBUTION: N. America (California).

Holotype: 1♀, Yosemite, California, 11.VI.1935, A. L. Melander (USNM, 68171).

Paratypes: California: 1♀, Yosemite, 10. VI. 1921, E. C. Van Dyke (U. CAL); 1♀, Snowline Camp., Eldorado Co., 30.VI.1948 (U. CAL); 1♀, Pyramid R. S., Eldorado Co., 12.VII.1948, L. W. Quate (U. CAL); 1♀, Giant F. Camp., Sequoia Nat. Pk., 21.VII.1953, A. & H. Dietrich (COR. U).

Arthroceras fulvicorne subsolanum Nagatomi, n. subsp. Fig. 6.

♀. There are 5 specimens from New Hampshire and Michigan which I have seen and which seem to be distinguished from typical *fulvicorne* by 5-6 segmented rather than 7 or 8 segmented flagellum of antenna (figs 5 and 6), although in other details all the characters appear to fit those of typical *fulvicorne*. [In 2 specimens from Michigan the relative length of segments of fore leg 172(164-179) : 213(207-218) : 100 : 37(35-38) : 34(33-35) : 24(22-25) : 37(36-37); of mid leg 205(200-210) : 230(227-233) : 93(92-93) : 34(33-35) : 30 (29-31) : 19(18-20) : 35(33-37); of hind leg 271(267-275) : 308(285-330) : 116(113-118) : 47(45-49) : 33(31-35) : 21(20-22) : 38(36-39)].

♂. No differences have been observed between typical *fulvicorne* and 2 specimens from Ontario [1♂, Burke Falls, 12. VII. 1926, F. P. Ide (CNC), and 1♂, Sudbury, 14.VII.1889, (COR. U)] which appear to belong in this subspecies, although in the latter venter of abdomen may be yellowish brown to brownish. (In 1 specimen from Ontario the relative length of segments of fore leg 165 : 200 : 100 : 38 : 30 : 23 : 33; of mid leg 177 : 223 : 95 : 40 : 30 : 20 : 30; of hind leg 238 : 253 : 112 : 48 : 35 : 20 : 33).

DISTRIBUTION: N. America (New Hampshire, Michigan).

Holotype: 1♀, Mt Washington, New Hampshire, Mrs Slosson (USNM, 68172).

Paratypes: Michigan: 1♀, Pequaming, 5. VII. 1903, Morgan Hebard (COR. U); 3♀♀, Marquette, 1911, Wm. T. Davis Coll. (COR. U).

Arthroceras japonicum Nagatomi 1954, Mushi **26**(4) : 13. Figs. 11-14, 19.

This species closely resembles *rubrifrons* but may readily be differentiated by the characters mentioned in the key. Addition to the original description is as follows.

The coloration of fore and mid femora (especially in ♀) and the size of blackish spot on the abdominal terga 2 and 3 (in ♂) vary with the district. The darkened area on the apex of wing (in ♂) variable in size.

♂. *Head*: Occiput with pale hairs which often change into shorter and black ones just behind upper margin of each eye; proboscis with pale or sometimes black hairs; antennal segments 1-2 intermixed with pale hairs; pile on facial swelling appear to be shorter and sparser than that on side of face; in the specimens at hand from Osumi, Kyushu, the hairs on ocellar triangle, vertex, and antennal segments 1-2 wholly pale; eyes joined for a distance usually more than length of ocellar triangle (0.8-1.5×); width of one eye on

a mid line from a direct frontal view more than distance from antenna to median ocellus (1.2-1.4×) and slightly over width of face at lowest portion from a direct frontal view (1.1-1.2×); face tapering on upper portion; distance from proboscis to antenna somewhat less than that from antenna to median ocellus (0.8-0.9×); width of facial swelling less than its length (0.6-0.9×) and about 1/2 width of face at top portion of facial swelling (0.5-0.6×); length of facial swelling over 1/2 distance from proboscis to antenna (0.7-0.9×); in antenna[4], which is as long as or somewhat shorter than distance from antenna to median ocellus (0.8-1.0×), segments 1-3 about 1/2 as long as rest (0.5-0.6×) and length of last segment equal to or approximately so the combined length of segments 1+2 (0.8-1.2×) and width of segment 3 (0.7-1.2×); in palpus, which appears to be shorter than distance from proboscis to antenna (0.7-0.9×), segment 2 is apparently less than 2× as long as (1.1-1.6×) and as broad as or narrower than (0.6-1.0×) segment 1 which is narrower than width of basal flagellar segment (0.6-0.9×); space between antennae less than width of ocellar triangle (0.3-0.6×).

Thorax: In mesonotum, pollen may be indistinct on narrow stripes and lateral borders including humeral and posterior calli; hairs confined to upper and posterior margins on mesopleura and below posterior spiracle and above mid coxa on pteropleura, and bare on hypopleura; sometimes mesonotum and mesopleura intermixed with black hairs.

Legs: Femora with black hairs which become longer and pale on posterior surfaces of fore and mid pairs and on posterodorsal surfaces (except apical portions) of hind one; in few cases, mid coxa intermixed with black hairs; in specimen from Sata, Osumi, fore and mid femora yellowish brown except for base; relative length of segments (excluding coxa and trochanter) of fore leg 131(122-142) : 170(165-179) : 100 : 36(32-39) : 28(24-31) : 18(17-19) : 24(22-26), of mid leg 139(131-152) : 179(173-187) : 89(81-94) : 34(32-37) : 26(22-28) : 16(15-19) : 24(22-25), of hind leg 200(184-209) : 234(224-244) : 98(89-105) : 39(36-45) : 27(24-29) : 17(15-19) : 25(22-27), these were calculated from 10 specimens; hind leg with basitarsus 1/7-1/9 as wide as long and narrower than (0.6-0.8×) tibia which is less than (0.6-0.7×) width of femur (these are almost in conformity with the ♀ of this species and both sexes of the others with which I am dealing in this paper).

Wings: Subcostal cell above stigma concolorous with stigma; proximal portion of darkened area on apex of wing is located at base of stigma but in some specimens it is near the apex of stigma.

Abdomen: Sternum 4 often with dark brownish to blackish area which is variable in extent and sometimes occupies the whole portion except the posterior border; posterior borders of sterna 5 and 6 (sometimes 5 only or 5-7) often yellowish brown or brownish; in specimens from Tosa, Shikoku and Osumi, Kyushu, spots on terga 2 and 3 broader than long; hairs on venter shorter than those on sides of dorsum and pale in color but black on sterna 6 and 7 (sometimes 5-7 or 7 only; in few cases, sterna 3 and 5 intermixed with black hairs); sternum 1 bare; hairs on tergum 1 wholly pale or almost so and those on sides of terga 6 and 7 (sometimes 7 only or 5-7) black as well as those in middle.

Genitalia: As in figs 11-14; possibly no significant difference is present between *japonicum* and *pollinosum*.

Length: Body 7.5-11 mm; wings 7-9.5; fore basitarsi 1.2-1.8.

4, The length and width of antenna were measured along the inner surface,

♀ (fig 19). *Head*: Hairs wholly pale on cheeks, wholly or chiefly pale on palpi, pale, black, or pale and black intermixed in each of proboscis, face, and front (face and front are often practically bare), chiefly black on antennal segments 1-2, black on ocellar triangle and vertex, either almost black or pale on occiput; in specimens from Higo and Osumi (Kyushu), hairs wholly or chiefly pale on antennal segments 1-2 and pale on ocellar triangle, vertex, and occiput (in 1 individual at hand from Higo, upper occiput and ocellar triangle with black hairs and antennal segments 1-2 and palpi with chiefly black ones); width of one eye at broadest point from a direct frontal view more than (1.2-1.4×) distance from antenna to median ocellus as in ♂, somewhat narrower than (0.7-0.9×) width of face at lowest portion from a direct frontal view, and equal to or broader than (1.0-1.2×) width of front at narrowest point (between facets), which is somewhat narrower than (0.7-0.8×) that at median ocellus; face tapering on upper portion as in ♂; distance from proboscis to antenna longer than that from antenna to median ocellus (1.1-1.4×); usually top of facial swelling is not definitely constricted and may extend to line drawn between antennae (in clearly defined specimens, width of facial swelling 0.7-0.8× its length and 0.6-0.7× width of face at top portion of facial swelling, and length of facial swelling 0.8-0.9× distance from proboscis to antenna); antenna longer than distance from antenna to median ocellus (1.2-1.5×), segments 1-3, 1/2 or somewhat more as long as rest (0.5-0.7×; usually 0.6) and length of last segment (of flagellum) equal to or roughly so the combined length of segments 1 and 2 (0.7-0.9×) and width of segment 3 (0.9-1.3×); palpi appear to be shorter than distance from proboscis to antenna (0.7-0.9×) as in ♂, segment 2 apparently longer than (1.4-1.8×) and as broad as or broader than (1.0-1.6×) segment 1 which is equal to or nearly so in width to basal flagellar segment of antenna (0.7-1.1×); space between antennae less than width of ocellar triangle (0.5-0.8×); viewed right above, width of eye somewhat less than its height (0.8×).

Thorax: Pollen and hairs as in ♂ but latter shorter than in opposite sex.

Legs: Fore and mid leg with femur blackish (except apex) in specimens from Honshu (Kai, Yamashiro, Tajima, Tamba, and Kii), but yellowish brown to brownish (sometimes except base), from Shikoku (Iyo and Tosa) and Kyushu (Higo and Osumi) and tibia more brownish in specimens from Shikoku and Kyushu than from Honshu; hairs on coxa sometimes chiefly black; in femur, hairs as in ♂ (although they are shorter) but those on posterior surface sometimes chiefly black; relative length of segments of fore leg 141(126-149) : 181(165-190) : 100 : 38(33-45) : 29(25-33) : 20(18-21) : 27(24-30), of mid leg 160 (146-167) : 196 (174-209) : 93 (86-100) : 34 (29-39) : 26 (22-30) : 17 (14-21) : 26 (24-28), of hind leg 218 (201-230) : 260 (238-278) : 106 (103-109) : 42(33-51) : 29(25-32) : 19(17-24) : 28(25-31), these were calculated from 10 specimens.

Wings: Subcostal cell above stigma concolorous with stigma as in ♂; proximal portion of darkened area on apex of wing located at or beyond apex of stigma.

Abdomen: Tergum 1 and sterna 1-4 with pale gray pollen which may not be so conspicuous as in segments 5-8; pile on abdomen pale but that in middle of terga 2-4 black; sternum 1 bare as in ♂; in specimens from Honshu, the hairs on sides of terga 3 and 4 at least partially black and those on sterna 3 and 4 sometimes black.

Length: Body 9.5-14.5 mm; wings 9.5-11.5; fore basitarsi 1.5-1.8.

DISTRIBUTION: Japan (Honshu, Shikoku, and Kyushu).

Type-locality: Tsurugiyama, Awa (Tokushima-Pref.), Shikoku.

Type in the University of Osaka Prefecture (formerly Naniwa University), Sakai, Osaka.

I restudied almost all of the type series, as well as the following additional specimens: Honshu: 1♂, 1♀, Gozaishi, Kai, T. Saigusa; 3♀♀, Hanase, Yamashiro, 6-7.VI.1961, S. Ito; 1♂, Hanase, Yamashiro, 7. VI. 1961, T. Kodama; 4♀♀, Kyoto, Yamashiro, 5.V-5.VI.1934-1948, T. Kimura; 1♀, Kyoto, Yamashiro, 10. VI. 1957, K. Iwata; 1♀, Sasayama, Tamba, 30. V. 1954, K. Nohara; 1♀, Sasayama, Tamba, 10. VI. 1956, A. Nagatomi; 1♀, Hyonosen, Tajima, 19.VI.1953, Nagatomi; 1♀, Mt Iwawaki, Kawachi, 26.V.1951, Kodama. Shikoku: 1♂, Totidani (nr Yanase), Tosa, 2.V.1951, Ito. Kyushu: 1♂, Mt Inunaki, Chikuzen, 13. V.1962, Saigusa; 5♀♀, Naidaijin, Higo, 25.V.1952, Kodama; 1♀, Mt Kirishima, Hyuga, 24. V. 1963, Nagatomi; 1♂, Osumiogawara, Osumi, 22. IV. 1962, Nagatomi; 1♂, 4♀♀, Sata, Osumi, 28.IV.1962, Nagatomi.

There is a ♂ specimen (Izumi, Satsuma, Kyushu, 1.V.1960, Y. Takemura) which differs very markedly from the description of *japonicum* in the following points: abdomen wholly blackish, although sternum 1 and sides of segment 2 with a brownish tinge and posterior margins of sterna 4-6 brownish; legs wholly blackish except for tip of fore femur; mesonotum with wholly black hairs, although posterior border intermixed with pale ones [the hairs on (1) vertex, (2) ocellar triangle, (3) antennal segments 1-2, (4) palpi, (5) proboscis, and (6) posterior surface of fore femur are black, although those on (3) and (4) appear to be partially pale]. This individual, whose body is almost wholly blackish (although the haltere is brownish and the basal about 1/2 of wing is tinged with yellowish brown), may possibly be a variety of *japonicum*.

Arthroceras leptis (Osten Sacken)

Arthropeas leptis Osten Sacken, 1878, Cat. Dipt. N. Am., Second Ed., p. 223.

Besides characters demonstrated in the key, this species may be differentiated from *fulvicorne* by the palpi in which segment 2 is 0.9-1.4× in ♂ and 1.1-1.9× in ♀ as long as segment 1, rather than 1.5-1.7× in ♂ and 2.0-3.0× in ♀.

The ♂ may be very similar to that of *subaquilum* (see page 59, last paragraph). The following notes supplement the description by Leonard (1930).

♂. *Head*: Basal portion of antennal segment 3 may be brownish; occiput except sides and frontal triangle bare; ocellar tubercle, facial swelling, and proboscis with rather short pale pile which is tinged with yellowish; antennal segment 2 with short hairs which may be chiefly or wholly pale; structural characters fit description of *japonicum*, but in specimens at hand width of one eye on a mid line from a direct frontal view is 0.9-1.0× width of face at lowest portion from a direct frontal view, width of facial swelling 0.9-1.1× its length, which is 0.6-0.7× distance from proboscis to antenna, 1st 3 antennal segments 0.7-0.8× as long as rest and palpal segment 2, 0.9-1.4× as wide as 1.

Thorax: Of 3 broad dark stripes (all of which end before posterior margin of mesonotum), median one begins at anterior margin of mesonotum and divided by a thin black vitta which recahes to posterior margin of mesonotum and lateral ones (which are dissected with gray at suture) are separated from humeri and connected with posterior calli; sternopleura, upper and posterior portion of mesopleura, and pteropleura just below posterior spiracle pale pilose.

Legs: Fore and mid femora with black hairs which are longer and pale on each posterior surface; hind femur short pilose (color of pile may be intermixed with pale and

black); relative length of segments of fore leg 170(166-172) : 213(205-217) : 100 : 37(36-37) : 32(30-38) : 23 (23-24) : 35 (33-36), of mid leg 179(176-183) : 220(213-224) : 91(87-94) : 37(36-40) : 30(28-31) : 21(20-21) : 33(31-34), of hind leg 234(230-236) : 275 (267-280) : 115(109-117) : 46(43-49) : 35(34-38) : 24(21-29) : 37(34-40), these were calculated from 4 specimens.

Genitalia: Probably no difference is present between *leptis* and *fulvicorne*.

Length: Body 6-7 mm; wings 6-7; fore basitarsi 0.85-1.0.

♀. *Head*: Ocellar tubercle, facial swelling, palpi, and antennal segment 2 with hairs as in ♂; upper occiput with hairs as in front; structural characters fit description of *japonicum*, but in specimens at hand width of one eye at broadest point from a direct frontal view 1.0-1.2× distance from antenna to median ocellus, 0.8-1.1× width of front at narrowest point, and 0.5-0.6× width of face at lowest portion from a direct frontal view, width of facial swelling 0.8-1.1× its length and 0.5× width of face at top portion of facial swelling, 1st 3 antennal segments 0.7-0.9× as long as rest, palpus 0.8-1.2× as long as distance from proboscis to antenna.

Thorax: Dark stripes on mesonotum and hairs on pleura as in ♂.

Legs: Hairs on femur as in ♂; relative length of segments of fore leg 161(156-167) : 203 (189-209) : 100 : 38(36-40) : 31 (29-33) : 23 (22-24) : 33 (31-35), of mid leg 178 (169-187) : 216 (200-227) : 93 (90-96) : 37 (33-40) : 31 (28-33) : 21 (20-22) : 31 (28-33), of hind leg 228(215-238) : 277(267-290) : 113(111-118) : 48(44-51) : 36(35-38) : 23(22-24) : 31(28-35), these were calculated from 6 specimens.

Length: Body 7-10 mm; wings 7-9; fore basitarsi 1.0-1.25.

There are 2 specimens (1♂, 1♀) of Siberia which differ from those of N. America in the following points: in ♂ the femur and in ♀ the coxa, femur, and scutellum brownish rather than dark brownish or blackish; in ♂, segment 2 of palpus 1.9× as long as 1, and last antennal segment 1.4× as long as segments 1 and 2 combined and 1.6× as long as width of segment 3 rather than they are 0.9-1.4×, 0.8-1.2×, and 0.7-1.3× respectively. (In ♂ the relative length of segments of fore leg 155 : 200 : 100 : 33 : 25 : 16 : 33; of mid leg 175 : 218 : 96 : ? : ? : ? : ?; of hind leg 229 : 263 : 110 : 41 : 31 : 16 : 33 and in ♀ that of fore leg 170 : 207 : 100 : 35 : 28 : 20 : 37; of mid leg 200 : ? : ? : ? : ? : ? : ?; of hind leg 257 : 306 : ? : 46 : 33 : 19 : 33). It appears, however, that the differences between them amount to no more than an infraspecific variation.

There is a ♀ specimen of Japan (Hokkaido) which differs from the specimens of N. America on hand by the front wholly heavily pale gray pollinose and facial swelling bare. (Relative length of the segments of fore leg 174 : 210 : 100 : 36 : 30 : 20 : 38; of mid leg 196 : 232 : 94 : 40 : 30 : 20 : 34; of hind leg 248 : 298 : 116 : 44 : 34 : 20 : 38). But these characters may be variable within the species and I prefer to treat it as *leptis* at present.

DISTRIBUTION: N. America (New Hampshire, New York, Michigan[5], Quebec, Ontario[5], British Columbia, and Washington), Siberia, and Japan (Hokkaido).

Type-locality: White Mts, New Hampshire.

Type in the Museum of Comparative Zoology, Cambridge, Massachusetts.

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5. After Leonard (1930).

SPECIMENS EXAMINED: New Hampshire: 2♂♂, Mt Washington, 20. VII. 1953, Blanton & Borders (COR. U); 1♀, Mt Washington, 2.VIII.1954, Becker, Munroe, & Mason (CNC); 2♀♀, Mt Washington, 14.VIII.1958, J. R. Vockeroth (CNC); 1♂, Mt Washington, 29.VII. 1961, W. W. Wirth (USNM). New York: 1♂, 1♀, Whiteface Mt, 14. VII. 1938, A. L. Melander (USNM); 1♂, 1♀, Whiteface Mt, 19.VII.1962, J. R. Vockeroth (CNC). Quebec: 1♀, Mt Oxford, 14. VII. 1936, C. E. Shewell (CNC). British Columbia: 2♀♀, Manning Park, 8-11.VIII.1953, J. E. H. Martin & D. F. Hardwick respectively (CNC). Washington: 1♀, Mt Rainier, Yakima Park, 14. VIII. 1940, A. L. Melander (USNM). Siberia: 1♂, Valentine, Bavsiberia, VII.1923, Cockerell (USNM); 1♀, Ussuri (USNM). Japan (Hokkaido): 1♀, Mt Daisetsu, 29.VII.1960, S. Takagi (KA. U).

Arthroceras pollinosum Williston Figs. 1, 3, 15-18.

Arthroceras pollinosum Williston, 1886, Ent. Am. 2(6): 108.
Leptis pruinosa Bigot, 1887, Bull. Soc. Zool. France 7: 115. [See Leonard (1931: 322); type-locality: Oregon; type in the British Museum (Natural History), London].

This species may be sharply distinguished from *fulvicorne*, *leptis*, and *subaquilum* by the characters mentioned in the key. The ♀ (resembles that of *fulvicorne*, but may be easily separated by the longer, more elongate antenna (1.6-2.2× as long as distance from antenna to median ocellus), the longer pile on hind femur, the dark brownish to blackish abdomen (although posterior border of each segment sometimes yellowish brown), and the smaller body (5.5-8 mm in length). The following notes supplement the description by Leonard (1930).

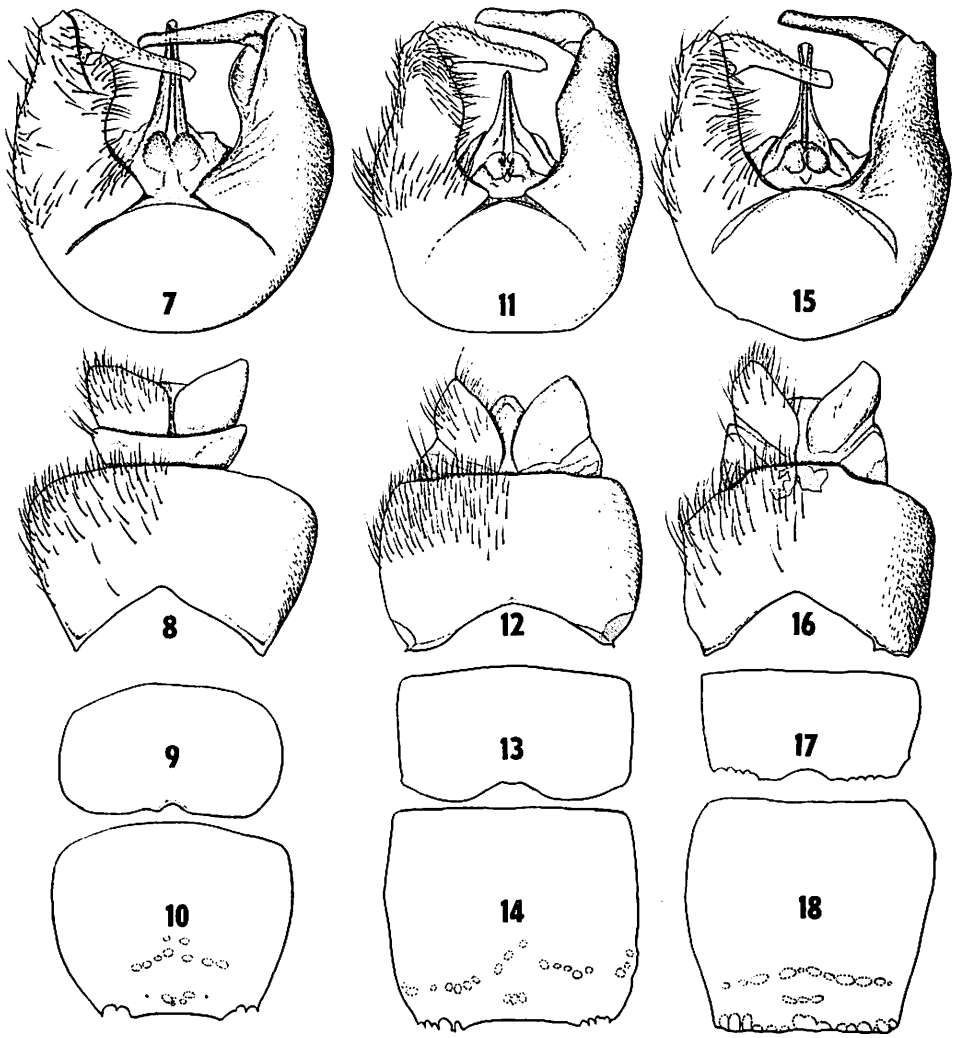
♂. *Head*: Frontal triangle, facial swelling, and occiput except sides bare (in some specimens, facial swelling with a very few pile); ocellar tubercle with fairly long pale hairs and antennal segment 1 and 2 with fine white pile; structural characters fit description of *japonicum*, but side of frontal triangle is usually angulated right above antennae, width of one eye on a mid line from a direct frontal view 0.9-1.1× width of face at lowest portion from a direct frontal view, distance from proboscis to antenna 0.9-1.1× that from antenna to median ocellus, antenna 1.1-1.3× distance from antenna to median ocellus, length of last segment 1.4-1.8× combined length of segments 1 and 2 and 1.7-2.3 × width of segment 3.

Legs: Hairs on hind femur long compared to those of *japonicum rubrifrons*, *leptis*, *fulvicorne*, and *subaquilum* (fig 1); in specimens from Oregon, whole surface or apical 1/2 or so of femur yellowish brown (concolorous with tibia) and coxa and trochanter with yellowish brown tinge; relative length of the segments of fore leg 166(160-176) : 199(193-208) : 100 : 35(32-38) : 27(23-31) : 20(17-24) : 32(28-36), of mid leg 182(177-189) : 220 (209-237) : 91(84-97) : 35(33-38) : 27(25-30) : 18(16-20) : 31(28-35), of hind leg 238(225-244) : 268(253-281) : 110(103-117) : 44(40-47) : 30(27-32) : 19(16-21) : 33 (30-36), these were calculated from 10 specimens.

Genitalia: As in figs 15-18; very similar in shape to *japonicum*.

Length: Body 4.5-6 mm; wings 4.5-6; fore basitarsi 0.6-0.8.

♀. *Head*: Facial swelling with a few pale pile; antennal segments 1-2 with pale pile as in ♂; upper occiput and ocellar triangle with pale yellowish hairs as in front; structural characters almost fit description of *japonicum*, but in antenna, which is 1.6-2.2× as



Figs. 7-18. *Arthroceras*, ♂ genitalia. 7-10, *A. f. fulvicorne* (from British Columbia); 11-14, *A. japonicum*; 15-18, *A. pollinosum*. [7, 11, 15: ventral view-(A); 8, 12, 16: epandrium and cerci, dorsal view-(B); 9, 13, 17 & 10, 14, 18: abdominal sterna 8 and 7 respectively (expanded; pubescence is omitted)-(C); magnification is same with (A) as with (B) but is different between (A) and (C)]

long as distance from antenna to median ocellus, segments 1-3, 0.4-0.5× as long as rest, length of last segment 1.3-2.1×combined length of segments 1 and 2 and 1.7-2.5× width of segment 3.

Thorax: Mesonotum with 3 broad, somewhat indistinct dark stripes all of which end opposite posterior margin of wing base (median stripe begins at anterior margin of mesonotum and lateral ones do just behind humeri).

Legs: Coxa and trochanter usually dark brown and pale gray pollinose as in ♂; hairs

on hind femur long as in ♂; the relative length of segments of fore leg 173(166-179) : 204(194-210) : 100 : 33(32-35) : 28(24-32) : 20(16-22) : 33(30-36), of mid leg 198(190-205) : 233(224-247) : 93(89-100) : 35(32-39) : 27(23-32) : 19(14-21) : 31(27-36), of hind leg 254(239-266) : 285(270-293) : 113(107-121) : 45(43-50) : 31(27-36) : 20(16-22) : 32(27-36), these were calculated from 7 specimens.

Length: Body 5.5-8 mm; wings 5.5-7.5; fore basitarsi 0.8-0.95.

DISTRIBUTION: N. America (Washington, Oregon, Idaho[5], Colorado, New Mexico, Wisconsin).

Type-locality: Washington or Colorado. Two syntypes, which I have not seen, are in the University of Kansas, Lawrence, Kansas.

SPECIMENS EXAMINED: Washington: 1♀, Canyon Creek, 26. VII. 1925, A. L. Melander (USNM). Oregon: 4♂♂, Corvallis, 20. VI. 1935, G. Ferguson (COR. U); 1♂, Portland, 6.VI.1915, A. K. Fisher (COR. U); 1♀, Forest Grove, 8.VI.1919, F. R. Cole (COR. U). Colorado: 12♂♂, 3♀♀, Doolittle Ranch, Mt Evans, 22.VII-6.VIII.1961, J. G. Chillcott, W. R. M. Mason, B. H. Poole, and S. M. Clark (CNC); 1♂, Aspen, 17.VII.1954, H. E. and M. A. Evans (COR. U); 1♀, Chicago Cr. 8800, Clear Cr. Co., 25.VIII.1961, C. H. Mann (CNC). New Mexico: 1♂, 1♀, Therma, 25. VII. 1932, A. L. Melander (USNM). Wisconsin: 1♀, W. M. Wheeler Collection (COR. U).

Arthroceras rubrifrons Nagatomi, n. sp.

This species is very similar to and may possibly be a subspecies of *japonicum* but is separated from latter by its coloration of stigma of wing (in both sexes) and that of front (in ♀) as shown in the key.

♀. *Head*: Reddish brown, but proboscis dark brownish to blackish and ocellar triangle and antennal segments 1-2 with a blackish tinge; often occiput (except cerebrale and area around it), cheeks, and sometimes including antenna, face and palpi, concolorous with proboscis; front just above antennae, antennal segments 1-2, face, palpi, proboscis, cheeks, and occiput light gray pollinose; hairs at least chiefly black on ocellar triangle, front and antennal segments 1-2, either chiefly black or pale on vertex, pale (a few black ones may be present) on face, pale or pale and black intermixed on palpi, pale on proboscis, longer and pale on cheeks; occiput with black hairs which change into pale on area near neck or with wholly or chiefly pale ones; structural characters agree closely with description of *japonicum*, although segment 2 of palpus is 0.8-1.0× as wide as 1 and in one specimen at hand width of facial swelling is equal to its length which is 0.7× distance from proboscis to antenna.

Thorax: As in *japonicum*.

Wings: As in *japonicum*, but stigma yellowish brown and not distinctly marked.

Legs and abdomen: As in specimens of *japonicum* collected from Honshu (Kai, Yamashiro, Tajima, Tamba, and Kii); in specimens at hand abdomen wholly blackish but terga 5-7 (except side) with a large yellowish brown tinge; the relative length of segments of fore leg 146(137-151) : 191(184-199) : 100 : 39(38-40) : 30(28-32) : 21(18-22) : 27(25-29), of mid leg 164(152-172) : 209(200-217) : 94(91-98) : 34(32-36) : 27(25-28) : 17(16-19) : 27(25-28), of hind leg 230(215-238) : 276(265-287) : 105(98-109) : 40(38-41) : 29(28-32) : 18(17-19) : 29(26-32), these were calculated from 4 specimens.

Length: Body 11.5-15 mm; wings 10-11.5; fore basitarsi 1.4-1.7.

♂. I have seen a ♂ specimen (Kariyoseyama, Musashi, 16. V. 1949, I. Hattori) which may belong to *rubrifrons*. The characters fit the description of *japonicum* both in color and in structures, but the stigma of wing is yellowish brown and not distinctly marked (in this individual the hairs on vertex and ocellar triangle were wholly pale); the relative length of the segments of fore leg 146 : 184 : 100 : 39 : 28 : 19 : 30; of mid leg 149 : 188 : 91 : 39 : 26 : 16 : 25; of hind leg 209 : 226 : 96 : 40 : 26 : 18 : 28.

Length: Body 9 mm; wings 8; fore basitarsi 1.4.

DISTRIBUTION: Japan (Honshu).

Holotype: 1♀, Mitake, Musashi, 22.V.1949, N. Fukuhara (NIAS).

Paratypes: 1♀, Takaosan, Musashi, 29.V.1949, S. Kato (NIAS); 1♀, Takaosan, Musashi, 29.V.1949, N. Fukuhara (NIAS); 1♀, Takaosan, Musashi, 22.V.1953, S. Ito (KA. U).

Arthroceras sinense (Ouchi), 1943, Shanghai Sizenkagaku Kenkyusho Iho **13**(6): 493.

This species is most closely related to *rubrifrons* but differs from latter by its thorax (in both sexes), legs (in both sexes), and abdomen (in ♀) yellowish brown. In *rubrifrons* the thorax (in both sexes), legs (in both sexes), and abdomen (in ♀) almost wholly blackish. The following is an abridged translation of the original description of this species.

"Body and legs wholly yellowish brown, wings tinged with yellowish, but the apical 1/3 darkened; in ♂ abdominal terga 1 and 5-7, and median spots of terga 2-4 blackish.

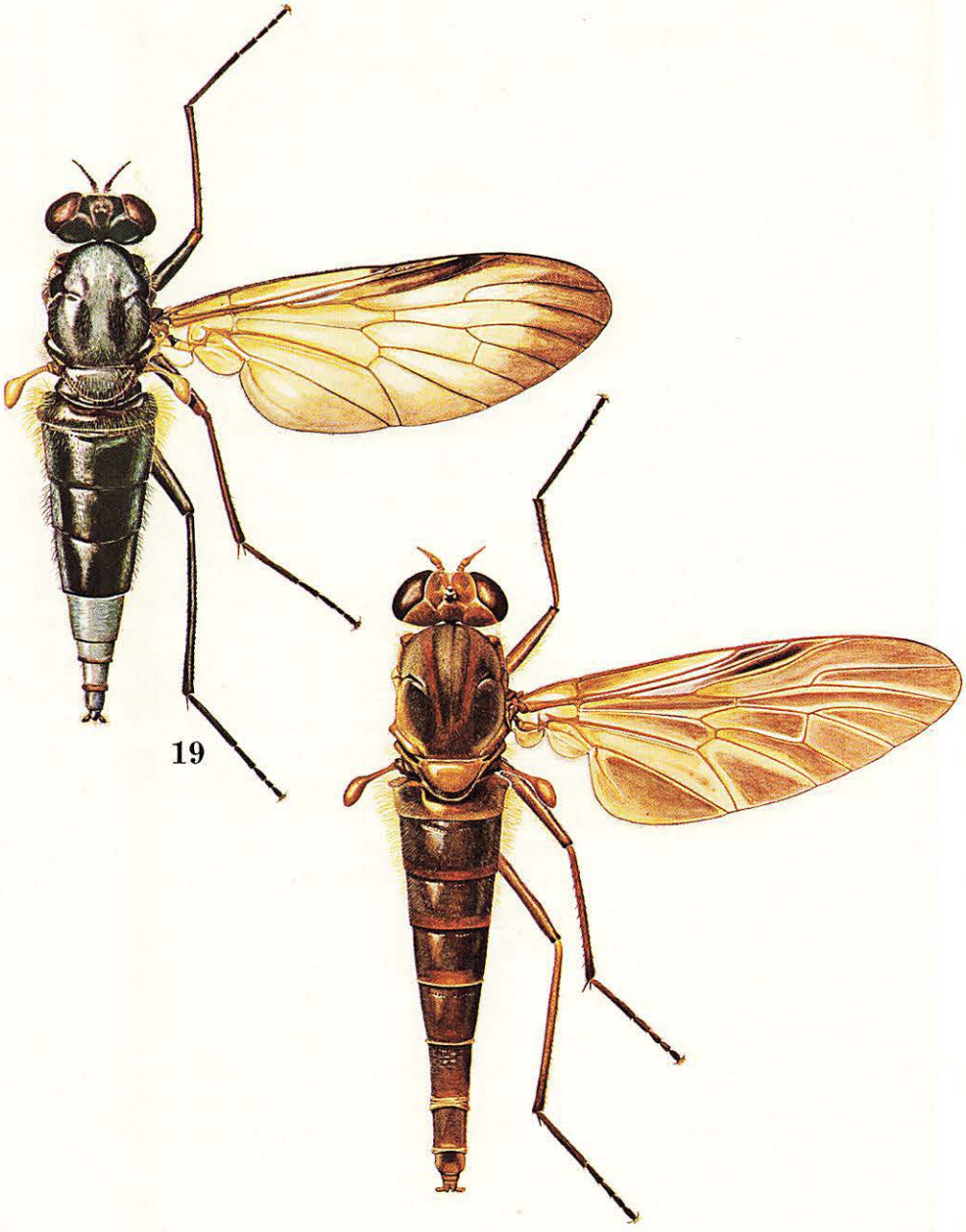
"♀. *Head*: Yellowish brown, but front (except just above antennae), segment 2 of palpus, and antenna yellowish red (last segment of antenna darkened) and proboscis yellowish; occiput golden pollinose; front with sparse short pale pile, vertex with yellowish hairs, face and front just above antennae covered with golden short pile, and facial swelling and side of face with sparse yellowish white hairs, occiput with reddish brown hairs which become golden on upper part, hairs on cheeks long and dense, and those on proboscis and palpi blackish brown, in antenna, 1st 2 segments with dark brown hairs and 3rd and last segments with black ones, and flagellum about 3× as long as the 1st and 2nd segments taken together, and last segment elongate.

"*Thorax*: Mesonotum dark yellowish brown and with a broad, median black stripe which extends from posterior 1/3 of mesonotum to anterior margin, scutellum and pleura pale yellowish brown; mesonotum, scutellum, pro-, meso-, and metapleura with yellowish brown hairs; haltere yellowish white.

"*Wings*: Membrane yellowish, but apical 1/3 darkened; veins orange yellow.

"*Legs*: Coxa, trochanter and femur orange yellow, and with pale yellowish brown hairs but apex of dorsal surface of femur with short black ones; hind femur is covered with short black hairs and becomes darker than fore and mid legs at first sight; tibial spurs yellowish red with tip black, claws shining black and pulvilli and empodium grayish yellow.

"*Abdomen*: Slightly broader than thorax, parallel-sided in segments 1-3 and then tapering posteriorly; terga 1-4 yellowish red, terga 5-7 yellowish white, genitalia yellowish red and slightly pale gray pollinose, hairs on dorsum black and not dense; venter pale yellowish brown and with some short black pile.



Figs. 19–20. 19, *Arthroceras japonicum* ♀ ; 20, *A. subaquilum*, ♀.

"Length: Body 13 mm.

"♂. Similar to ♀ except as follows: More grayish than in ♀; in abdomen, terga 1 and 5-7 wholly blackish and terga 2-4 each with a median, basal blackish spot which reaches to posterior margin (these spots are gradually larger posteriorly); in wing, apical 1/3 is darkened as in ♀ and an infuscated spot is present extending over 5th posterior cell and anal cell; hairs on mesonotum and abdominal dorsum are conspicuous and those on latter (as well as on former) black in middle and yellowish white on sides; abdominal terga 5-7 wholly black pilose.

"Length: Body 11 mm.

"DISTRIBUTION: Two ♂♂ and 2♀♀, Tienmushan, Chekiang Province, E. China.

"Type is deposited in the Department of Biology, the Shanghai Science Institute, China."

Arthroceras subaquilum Nagatomi, n. sp. Fig. 20.

The ♀ of this species is very similar to that of *fulvicorne* but may be distinguished from the latter by the following points: flagellum of antenna largely darkened, abdominal terga 2-4 largely dark brownish to nearly blackish (fig 20), and stigma of wing dark brown. The ♀ is easily separated from that of *leptis* by having the head, palpi, thorax, and haltere wholly and abdomen partially yellowish brown to brownish. As to the ♂ of *subaquilum*, see below.

♀ (fig 20). *Head*: Yellowish brown to brownish, with pale gray pollen which may be tinged with yellowish; flagellum of antenna except for basal portion of its 1st segment and proboscis darkened and ocellar triangle with blackish tinge; hairs and structural characters as in typical *fulvicorne*, but in specimens at hand space between antennae 0.8-0.9× width of ocellar triangle.

Thorax: As in typical *fulvicorne*; in specimens on hand the broad stripes on mesonotum distinct.

Legs: As in *fulvicorne*; often tarsus blackened and tibia more or less darkened; the relative length of segments of fore leg 174(166-179) : 210(196-219) : 100 : 35(34-36) : 31 (29-33) : 23(22-24) : 33(29-35), of mid leg 200(190-205) : 232(219-242) : 93(92-95) : 35 (34-36) : 28(27-29) : 21(19-22) : 30(27-33), of hind leg 254(234-265) : 311(295-327) : 113 (103-122) : 42(41-43) : 32(29-35) : 21(20-22) : 31(27-35), these were caluculated from 3 specimens.

Wings: Membrane tinged with dark brown, but veins, which are largely yellowish brown, bordered with yellowish brown; stigma and apical portion of subcostal cell dark brown.

Abdomen: Yellowish brown to brownish, but terga 1-4 (sometimes 1-8) except posterior borders dark brownish to nearly blackish and sterna 2-4 (sometimes 2-7) concolorous with terga (sometimes sterna 3 and 4 almost wholly brownish); sternum 1 often partially dark brownish to nearly blackish; the hairs as in *fulvicorne*.

Length: Body 8-9 mm; wings 8.5-9.5; front basitarsi 1.1-1.2.

♂. A ♂ specimen from Montana (Lake McDonald, Glacier Park, 13.VI.1935, A. L. Melander) may possibly be relegated to this species. This individual resembles the specimens of *leptis* but differs in the following respects: Hairs on palpi, antennal segment 2,

ocellar triangle, vertex, and middle of abdominal dorsum black; femur brownish rather than nearly blackish; wings somewhat similar in color to ♀ of *subaquilum* mentioned above. This individual is separated from the specimens of *fulvicorne* by having the antenna (except for basal portion of 1st segment of flagellum) and the palpi blackish. (In this specimen the relative length of segments of fore leg 165 : 198 : 100 : 35 : 29 : 23 : 31; of mid leg 169 : 202 : 90: 35 : 27 : 19 : 29; of hind leg 233 : 265 : 115 : 42 : 31 : 21 : 31).

DISTRIBUTION: N. America (Alberta, British Columbia, Montana).

Holotype: 1♀, Banff, Alberta, 27.VII.1935, A. L. Melander (USNM, 68173).

Paratypes: Alberta: 1♀, Waterlor, 14.VII.1923, H. L. Seamans (USNM). Montana: 1 ♀, Glacier Park, 3.VIII.1935, A. L. Melander (USNM). British Columbia: 1♀, Robson, 17.VII.1950, H. R. Foxlee (CNC)

Discussion

The members of *Arthroceras* may be divided into the following 3 groups: (a) *pollinosum* whose distribution appears to be limited to the western portion of N. America, namely, Washington, Oregon, Idaho, Colorado, New Mexico, and Wisconsin; (b) *fulvicorne*, *leptis*, and *subaquilum* whose range extends through N. America excepting the SE United States, Siberia, and Japan (Hokkaido); (c) *japonicum*, *rubrifrons*, and *sinense* whose habitat is E. China and Japan (Honshu, Shikoku, and Kyushu).

In *leptis*, whose habitat is (1) N. America (New Hampshire, New York, Michigan, Quebec, Ontario, British Columbia, Washington), (2) Japan (Hokkaido), and (3) Siberia, the specimens of (3) may possibly be different subspecifically or specifically from those of (1) or (2). In *fulvicorne*, whose habitat is (1) New Hampshire and Michigan (as *fulvicorne subsolanum*), (2) British Columbia, Washington, Idaho, Oregon, Utah, and Colorado (as *fulvicorne fulvicorne*) and (3) California (as *fulvicorne nigricapite*), the specimens of (1), (2), and (3) may not be "taxonomically different" from one another. The available material is still very scanty, and the details are not known so far.

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